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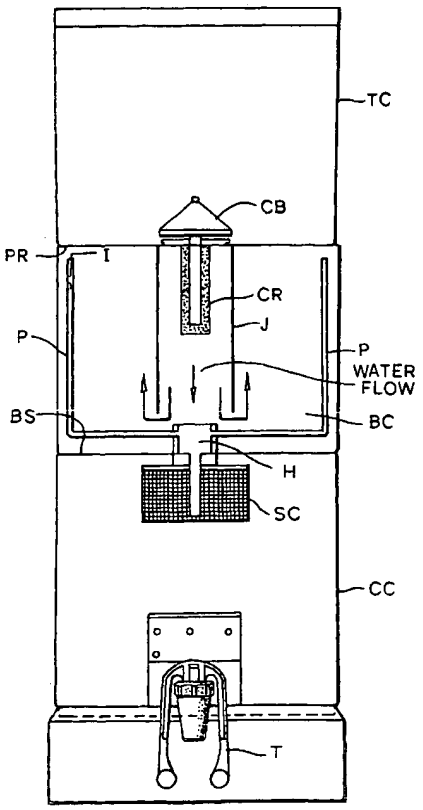
(54) Title: WATER PURIFICATION SYSTEM



(57) Abstract: The invention provides a gravity fed water purification system comprising a filtration unit adapted to filter particulate material, and a chemical purifying unit containing a chemical purifying agent, in which the chemical purifying unit is housed in a sealed chamber and is in fluid communication with the filtration unit such that water treated by the filtration unit is then gravity fed into the chemical purifying unit and retained therein for a predetermined period, after which the water exits the system via a scavenger means which is adapted to recover leached chemical purifying agent. The system ensures the delivery of microbiologically pure water of high quality whilst maintaining the simplicity and advantages of gravity fed filtration systems.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WATER PURIFICATION SYSTEM

Field of the Invention

The present invention relates to a water purification system and in particular to a gravity fed water purification system for the generation and dispensing of purified water of superior quality.

Background and Prior Art

It is very important to improve the technology relating to water purification as the water supplies are becoming increasingly polluted. Many water bodies have become contaminated to a great degree and thus require superior water purification systems.

The presence of unwanted and potentially harmful contaminants in water, especially drinking water, is of concern to many people. This concern creates a desire for water treatment devices in the home and elsewhere. Many water treatment devices and methods have been developed to remove or neutralise chemical and particulate contaminants. Some of these devices and methods incorporate chemically active materials to treat the water. For example, activated carbon is capable of removing the bad taste and odour from water as well as chlorine and other reactive chemicals. Ion exchange resins are useful for removing metal and other ions from water. However, no single material or chemical has been found that will remove all contaminants.

In addition to chemical and particulate contaminants, water often contains biological contaminants. These contaminants often can not be entirely removed by activated carbon, ion exchange resins, or other chemically active water purifiers. The biological contaminants may be susceptible to harsher chemical treatment, but such chemicals are, typically, themselves contaminants or can not be easily incorporated in gravity-fed treatment devices, especially those for household use. In addition to being resistant to removal by standard chemical means, many of these biological contaminants, such as protozoan cysts like cryptosporidium, are only a few microns in size.

Several water purifying systems are available. Purifying tablets, boiling etc are commonly used. Water treatment devices are well known in the art. Such devices are employed directly in a water system, either in-line or at the terminal end, or in self-contained batch systems. An example of an in-line system is an under the counter device which filters water prior to reaching the faucet. Terminal end devices include counter top and faucet mounted filtration. Self-contained batch systems include gravity fed systems or carafe units.

Iodinated resin systems have also been employed to disinfect drinking water. These systems involve iodide molecules in a resin bed, formed of beads of iodide molecules tightly bound to a base copolymer, ion exchange resin, usually a styrene/divinyl benzene (DVB) copolymer. Water passing through the resin bed becomes turbulent. The turbulence forces the microbes, such as bacteria, protozoan cysts and

viruses, into substantial contact with the iodinated beads. As a result of these contacts, iodine is transferred to the microbes as molecular iodine, where it undergoes a redox reaction with the microbes, deactivating them.

The iodine is also eluted into the water in minute amounts, typically about 0.5 parts per million (ppm). The exact amount of residual iodine given off is a function of residence time, temperature, flow rate, as well as the level and type of ions in the input water.

US 5518613 (Harrison First International, Inc. 1996), discloses a portable water purifying and drinking device that is designed to eliminate potentially harmful parasites 1-2 microns in size, from the water to be purified. The device includes a chemical purifying agent and a residence chamber that allows an induction period for the purifying to take place. This functioning of this device is dependent on the pressure drop required to move the fluid through the conduit, which is in the range of 1-5 psi (generated by the user's mouth by suction).

Use of carbon blocks to filter out cysts is also known as a purification media.

WO9529878 (Recovery Engineering Inc. 1995), discloses a water purifying device, comprising a disinfecting unit comprising an iodinated resin unit and an activated charcoal unit. The basic principle is that the volume dimensions and liquid flow rate in the wait time chamber are maintained to deactivate bacteria, viruses and other contaminants. It is

also essential that the liquid stream proceeds uniformly such that the first portion of liquid to enter the unit leads the liquid stream and does not mix with liquid that entered prior to or after that.

It has however been experienced that it is not possible to achieve desired removal of cysts by using iodinated resin and by only maintaining plug flow and manipulating the wait time.

Thus, in spite of the above available knowledge and various forms of filtration/purification means presently known it has not been possible to achieve the desired high microbiological purity in simple gravity fed filtration systems.

The present invention provides a simple and cost-effective gravity fed water purification system with the desired high microbiological purity. The system is conveniently adaptable for household/residential use in varying dimensions according to user requirements.

Summary of the Invention

The present invention provides a gravity fed water purification system comprising a filtration unit adapted to filter particulate material, and a chemical purifying unit containing a chemical purifying agent, in which the chemical purifying unit is housed in a sealed chamber and is in fluid communication with the filtration unit such that water treated by the filtration unit is then gravity fed into the

chemical purifying unit and retained therein for a predetermined period, after which the water exits the system via a scavenger means which is adapted to recover leached chemical purifying agent.

Advantageously, the system of the invention effectively combines a filtration unit for particulate material and a chemical purifying unit, so that not only particulates (typically those greater than 2 micron size) are separated, but also the filtered particulate-free water is subjected to subsequent treatment with a chemical purifying agent for a sufficient period to ensure the delivery of microbiologically pure water of high quality whilst maintaining the simplicity and advantages of gravity fed filtration systems.

Detailed Description and Preferred Embodiments

The gravity fed water purification system of the invention typically comprises a purification unit comprising a top chamber and a bottom chamber, which are separated by a partition. The filtration unit is typically secured to the partition and housed in the top chamber, and the chemical purifying unit is housed in the bottom chamber.

Preferably the filtration unit comprises a carbon block.

In order to facilitate effective treatment it is important that the water resides for a sufficient time in the chemical purification unit.

Typically this is achieved by positioning of a water exit passage from the chemical purifying unit in a configuration such that water cannot exit through the water exit passage until it has resided for a defined time in the chemical purifying unit.

Preferably the water exit passage comprises one or more pipes which have an inlet that is positioned just below the partition between the top and bottom chambers.

The water exit passage is connected to the scavenger means which is adapted to recover leached chemical purifying agent. Preferably the scavenger means comprises bacteriostatic activated carbon encased by a collection chamber.

Specific examples of a water purification system according to the invention are illustrated in Figures 1 to 3. As illustrated in Figure 1, the system comprises a purification unit having a top chamber (TC) and a bottom chamber (BC) separated by a partition (PR). A carbon block (CB) is fitted on the upper side of the partition which is in fluid communication with a resin cartridge (CR) on the bottom chamber (BC). The resin cartridge (CR) contains chemical purifying agent. The bottom chamber (BC) is provided with pipes (P) emerging from the bottom sealed side (BS) which extend to a level just below the partition (PR). The dimensions and disposition of the pipes (P) govern the residence time of the water in the bottom chamber (BC) and thus its exposure to the purifying agent in the resin cartridge (CR). Water exiting from the resin cartridge (CR)

is guided by a cylindrical downcomer (J). The water collects in the chamber (BC) until the level of the water has reached the inlet (I) of the pipes (P) and flows down into a common header (H) which then leads to the scavenging unit (SC) which is overhanging in the dispensing chamber (DC). The water collected in collection chamber (CC) can be dispensed through a tap (T) for use.

Figure 2 is another embodiment of the invention where the system comprises a purification unit with a top chamber (TC) and a bottom chamber (BC) separated by a partition (PR). A carbon block (CB) is fitted on the upper side of the partition (PR) and in fluid communication with a resin cartridge (CR) located on the lower side of the partition (PR). Water collected in the bottom chamber (BC) is transported down to a collection chamber (CC) provided at the base (B) of the unit. The water collects in the collection chamber (CC) until the level of the water has reached the scavenging unit (SC) which is in fluid communication with the collection chamber (CC). The water after passing through the scavenging unit (SC) is collected in the dispensing chamber (DC) and can be dispensed through a tap (T) for use.

Figure 3 is a further embodiment of the invention which can be fitted on to a bubble top dispenser with a pressure equalising device.

As illustrated in Figure 3, the system comprises a purification unit having a top chamber (TC) and a bottom chamber (BC) which are maintained in air tight sealed

conditions and separated by a partition (PR). A carbon block (CB) provides filtration of particulate matter and a cartridge (CR) provides chemical purification. To maintain equal pressure between the top of the bottom chamber and the top of the top chamber there is provided a pressure equalising device/valve (PV). The chamber (C) is provided with pipes (P) emerging from the bottom sealed side (BS) which extend to a level just below the partition (PR). The water collects in the chamber (C) until the level of the water has reached the inlet (I) of the pipe and flows down into a common header (H) which then leads to the scavenging unit (SC) which is overhanging in the bottom chamber (BC). The purification unit detailed above is installed on top of the dispensing chamber (DC) and is maintained in operative communication with a dispenser via a central opening in the bottom chamber which further extends in the form of a nozzle (NZ) into the dispenser top. The dispenser is provided with a tap (T) through which regulated supply of the purified water can be achieved.

The operation of the system according to the invention is as follows:

The purification system comprises of a top chamber fitted with a pre-filter made of a coarse sediment filter and activated carbon to enable removal of chlorine, organics, particulate matter and pathogenic cysts. The filtered water then goes through a chemical purification unit which has a chemical purifying agent such as iodine or chlorine suitably impregnated on a inert carrier such as ion exchange resin. As the water passes through the chemical purification unit

it leaches out a certain amount of the chemical purifying agent from the resin. The chemical purifying agent is then scavenged by passing the water through a unit comprising bacteriostatic activated carbon and/or ion exchange resin or any other known means after a residence time which is a period of not less than 30 minutes of its exit from the chemical purifying unit.

It is preferable that the residence time is in the range 30 to 300 minutes and more preferably 60-180 minutes.

Demonstration of microbial kill and cyst removal:

1200 litres of Mumbai municipal supply of tap water was contaminated with 10^7 counts/ml of bacteriophages, 10^5 counts/l cysts, and 10^8 counts/ml bacteria, to have only one type of the micro-organism at a time. The water was filtered through the water purifier according to the invention as described in Figure 1 (Example 1). In Example 2 the construction of the water purifier was according to Example 1 but the carbon block was not introduced. In Example 3 a conventional type filter was used.

Table 1

Examples	Bacteriophages	Cysts	Bacteria
Example 1	Nil	Nil	Nil
Example 2	Nil	10^5 counts/l	Nil
Example 3	10^4 counts/ml	Nil	Nil

The data presented in table 1 show that the water purifier according to the invention achieves complete microbial kill.

CLAIMS

1. A gravity fed water purification system comprising a filtration unit adapted to filter particulate material, and a chemical purifying unit containing a chemical purifying agent, in which the chemical purifying unit is housed in a sealed chamber and is in fluid communication with the filtration unit such that water treated by the filtration unit is then gravity fed into the chemical purifying unit and retained therein for a predetermined period, after which the water exits the system via a scavenger means which is adapted to recover leached chemical purifying agent.

2. A water purification system according to claim 1, which comprises a purification unit comprising a top chamber and a bottom chamber, which are separated by a partition, and in which the filtration unit is secured to the partition and housed in the top chamber, and the chemical purifying unit is housed in the bottom chamber.

3. A water purification system according to claim 1 or claim 2, in which the filtration unit comprises a carbon block.

4. A water purification system according to any one of claims 1 to 3, in which a water exit passage from the chemical purifying unit is provided in a configuration such that water cannot exit through the water exit passage until it has resided for a defined time in the chemical purifying unit.

Fig.1.

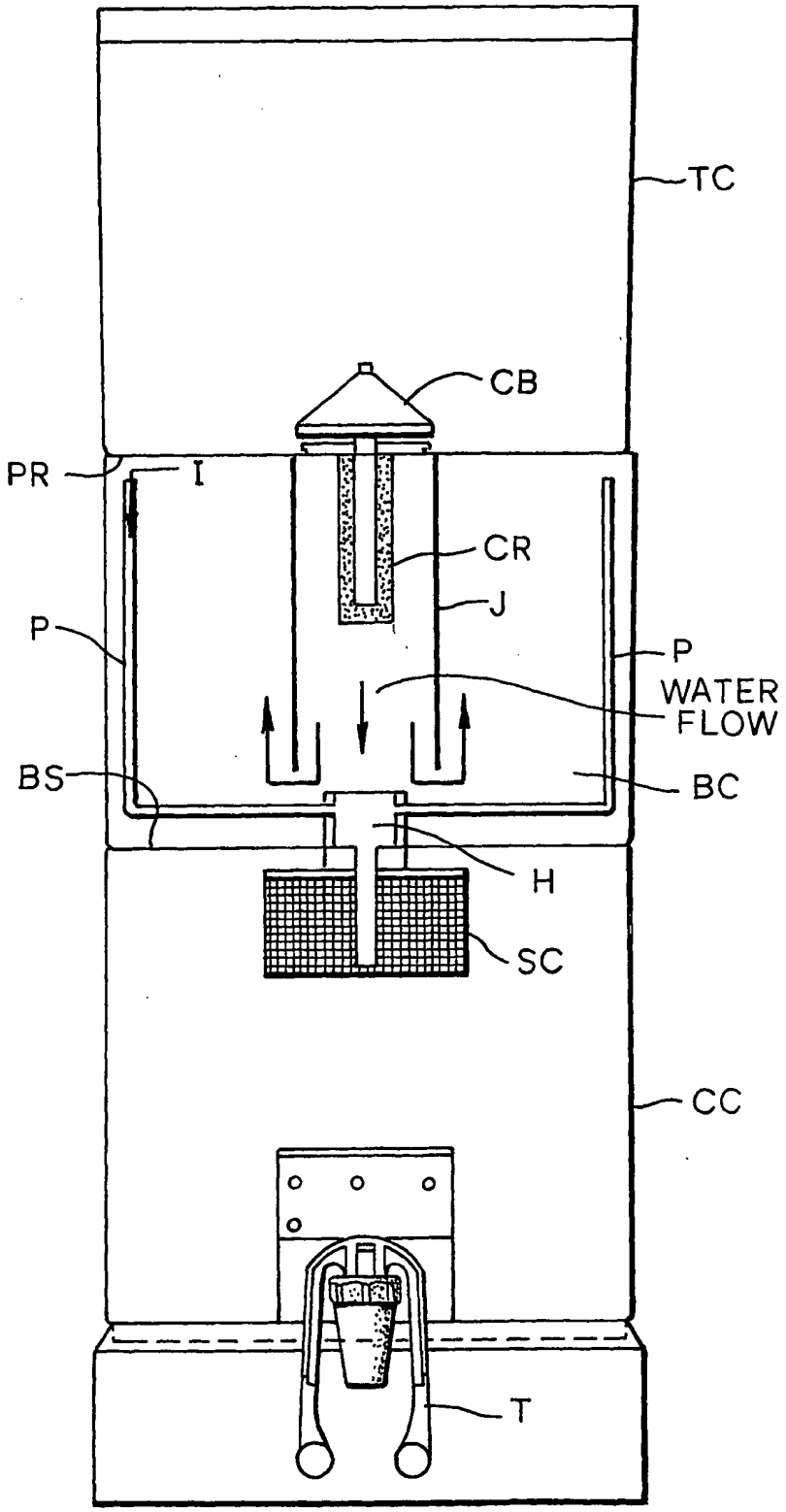


Fig.2.

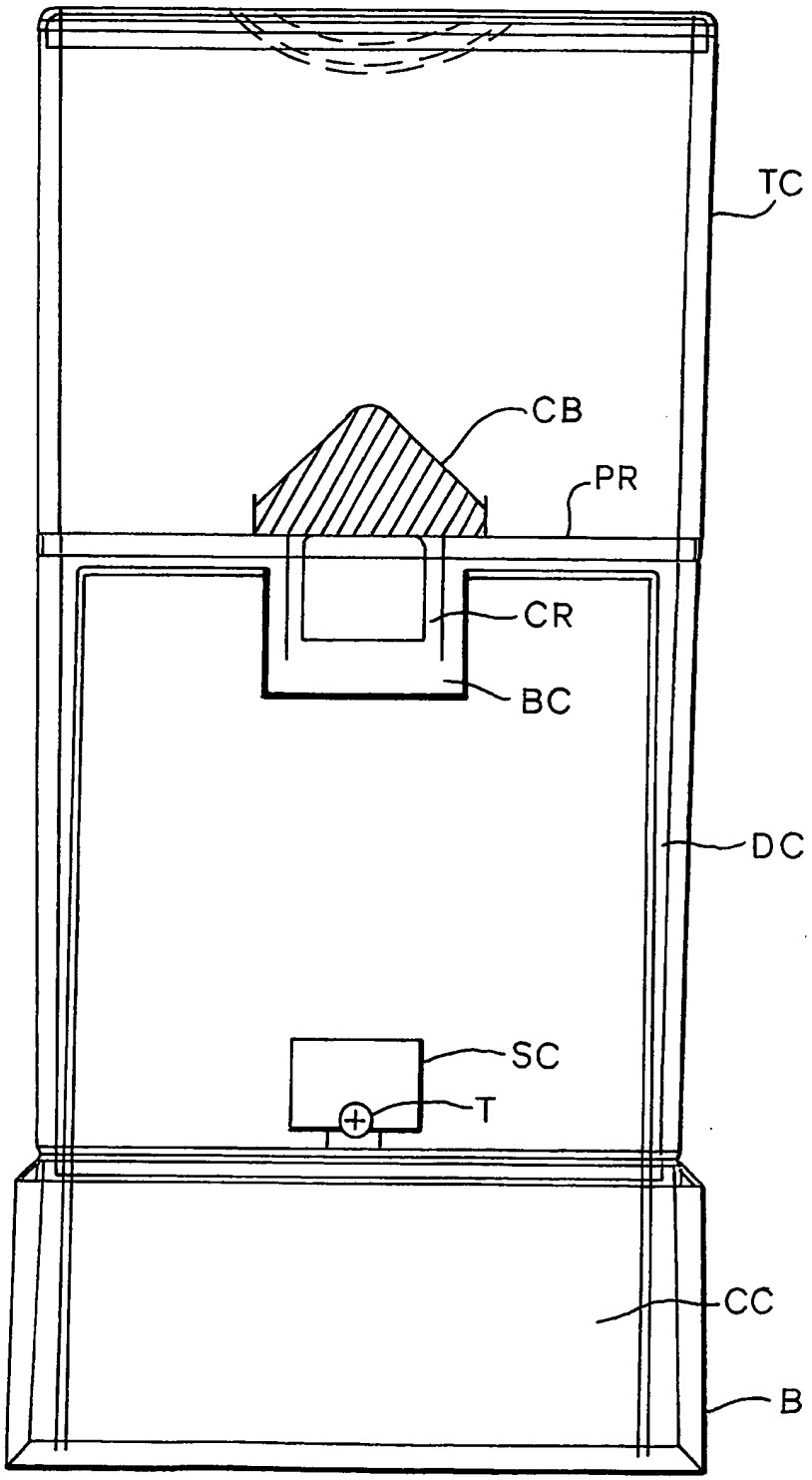
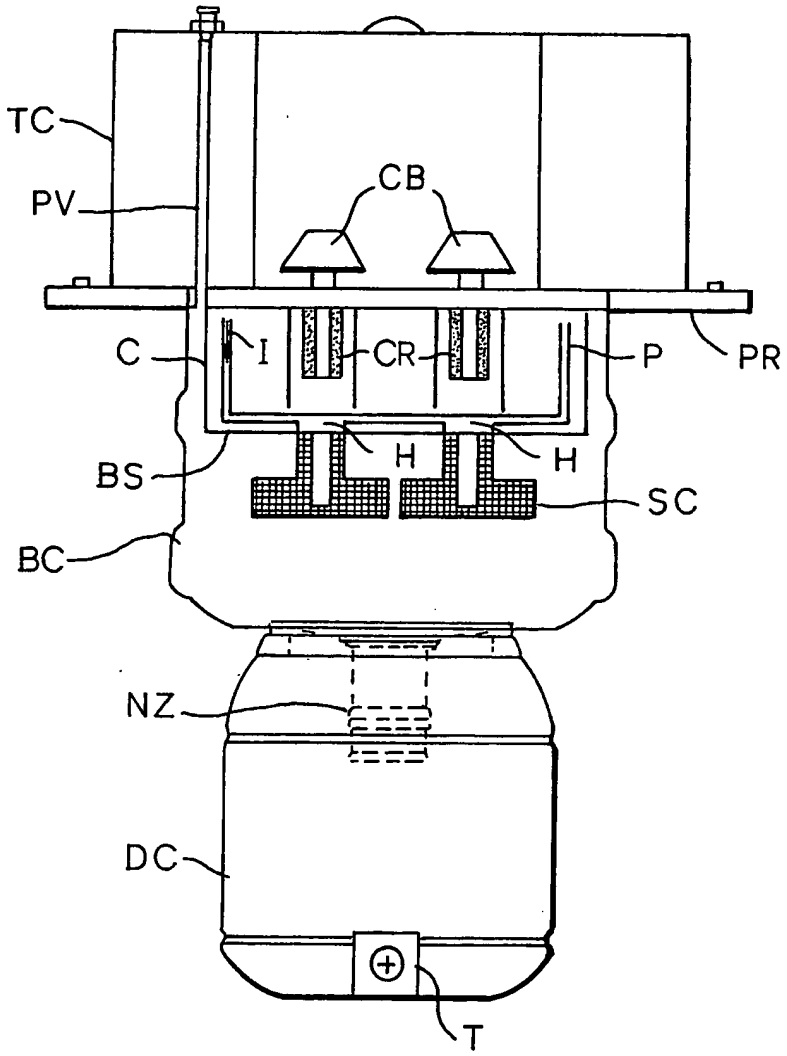


Fig.3.



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C02F1/00 C02F1/28 C02F1/76 C02F1/42 C02F9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
PAJ, EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 308 482 A (MEAD ROBERT J) 3 May 1994 (1994-05-03) column 1, line 40-45; figure 3 column 2, line 23 -column 3, line 16 column 4, line 9 -column 5, line 48 ---	1-4
X	US 5 562 824 A (MAGNUSSON JAN H) 8 October 1996 (1996-10-08) column 1, line 5 -column 2, line 60 column 3, line 17-25 column 4, line 1-12 column 5, line 61 -column 6, line 58; claims 1-5; figures 1-7 --- -/--	1-4

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

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PCT/EP 03/05468

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 061 367 A (HATCH GARY L ET AL) 29 October 1991 (1991-10-29) column 2, line 66 -column 3, line 47 column 5, line 67 -column 6, line 24 column 7, line 38-46; claims 1-4,10,11; figures 2-4	1-4
Y	US 4 714 546 A (GOOD CHARLIE J ET AL) 22 December 1987 (1987-12-22) column 3, line 29 -column 4, line 56; figure 2	1-4
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Information on patent family members

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